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TIME AS A FOURTH DIMENSION

THE present century has seen several developments which have thrown into speculative prominence a reconsideration of the structure of space: suggestions that space does not conform to Euclidean rules, that it involves more than three dimensions, and that perhaps one of these extra dimensions is time. The purpose of the present article is to inquire into the meaning of such propositions and the reasons for holding or rejecting them.

In particular we are interested in the present article in an investigation into the validity of the assumption that time is really equivalent to space, and we shall investigate this suggestion, in so far as possible, in terms of its mathematical, physical, and philosophical implications.

If time is one of four equivalent dimensions, any general statement applying to time must apply to each of the spacial dimensions; any statements applying to a spacial dimension must apply to time; any statements true of two or three dimensions taken together must be true of any other set of two or three dimensions; and in any equation expressing the behavior of objects, for each appearance of a term involving one dimension or set of dimensions, there must appear identical expressions of each of the other dimensions or sets of dimensions.

Each of these statements appears to be fallacious. To begin with, there are statements we can make about time that are not true of space: e.g., time is not reversible.

This statement is countered by the argument that the direction of time is psychological: that for a Being outside of our universe and considering it, the reverse direction would be just as meaningful as the forward direction. The example of the motion picture film is commonly given: it can be run through the projector backwards to produce a picture with as much continuity as it has in the forward direction.

Mathematically, any term which assumes values which form a well-ordered set, everywhere dense, and having no terminations, may be taken as a dimension. In this sense time is certainly a dimension along with color, vibration rate, beauty, and so forth. But evidently it is not in the strict mathematical sense that a fourth

dimension is proposed: to satisfy the proposed theory time must not only be mathematically dimensional but also be analogous to the spacial dimensions and in some way convertible into them. Let us take the empirical approach first.

To revert for analogy to the adventures of "A Square" in "Flatland," time as experienced by A Square was the same time as that experienced by three-dimensional beings. It was therefore possible for a three-dimensional being, a sphere, to converse with A Square, and even to touch the interior of his body. But if A Square's time were the spacial third dimension of the superior being, conditions would be different. A Square's future would, in the eyes of the cube, be superimposed upon his present, with his past underneath, the whole being a solid whose every horizontal cross-section is a square. So A Square's future and past would protect his insides from being touched by the sphere. More importantly still, A Square would not have any dimension corresponding to the sphere's time. No event in the sphere's life could have an effect upon A Square, and Flatland could be no recognizable or lawful part of the three-dimensional world's existence. In fact, the two would be different universes, not related as whole to part.

If the three-dimensional space and one-dimensional time we experience constitute a homogeneous continuum, say noumenon, for some transcendental being, say a truly eternal God, then it is impossible to relate the transcendental realm to our own experience. A mystical, indefinable relationship of being basic, noumenon to phenomenon, may be posited; but in the absence of temporal relationship, the noumenon neither caused nor existed before the phenomenon.

Thus we see, on the one hand, that the problem is new neither to philosophy nor to religion; and, on the other hand, that popular writers have been altogether wide of the mark in their treatment of the subject. It has often been said that in four dimensions it would be possible to turn a solid into its mirror image, just as the plane-figure F can be turned in three-dimensional space into the figure ⅎ. But as the turning of the figure F is a temporal movement in three-dimensional space, requiring time in addition to the three spacial dimensions, so the inversion of a solid would require, not time as a fourth dimension, but a fourth spacial dimension plus time. Likewise, any being dimensionally superior to us, to have control over us, would have to exist in our time and our space, and have, in addition, another spacial dimension.

The picture of the temporal history of A Square as a solid, of a particle as a life-line, of a man as a four-dimensional super-solid,

requires us to conceive of an individual occupying in succession consecutive cross-sections of the solid, line, or four-dimensional continuum. The conception of "in succession," however, is a temporal one, and since time has already been used in a spacial sense, an additional and truly temporal dimension must be added. When H. G. Wells wrote about a "time machine," and had his Time Traveller take four hours to spend eight days in a time eight hundred thousand years in the future, he used three different temporal dimensions: the time in which the machine travelled, the experienced time of eight days, and the time it took to accomplish the trip. Identifying these different times with each other has many paradoxical results; a man could go back into past time and change the course of history, even to the extent of bringing it about that he would never be born, and hence never take his backward trip into the past!

The fallacies of Wells are obvious enough, and even intentional: I mention them to lead up to the more important blunders of those mathematicians who, seeing that a three-dimensional non-Euclidean space may be represented as a section of a four-dimensional Euclidean one, suggest that the extra dimension really exists and is identical with our time. Now it is convenient at times to think of a non-Euclidean space in terms of a higher-dimensional Euclidean continuum, but there neither is nor can there be any evidence of the real existence of the continuum—that is to say, of that part of it which is not the cross-section in which we live. Its existence is possible, but outside of our universe and completely transcendental to our experience. This much we can say, however; that if it does exist, the fourth dimension involved is not our time.

A conception that has been popular for the past twenty years or so is that space is recurved upon itself in time, much as a line curved in a second dimension becomes a circle, in such a way that both space and time are finite and yet unbounded. Such a belief, as far as space alone is concerned, may be true in effect: it would mean that we live in a Lobatchefskian-type space rather than in a Euclidean one. And as stated before, it is mathematically valid and psychologically useful to conceive of this Lobatchefskian space as a three-dimensional super-surface in four-dimensional Euclidean space. Yet this fourth dimension is not time, for the super-surface has only three dimensions, including time, while our world has four spacio-temporal dimensions. We might, however, be living in a four-dimensional super-surface in a five-dimensional Euclidean continuum, provided that the surface be considered analogous to the cylinder rather than the sphere.

For in any case, the concept of time as recurved upon itself involves insuperable objections. It would mean that world history identically repeats itself, so that there could be no indeterminism of any event; that a teleological determinism is identically as valid as causal determinism; that the concept of causality or determination is formally incorrect even though practically valid; that the findings of modern physics that suggest indeterminism are incorrect; and that the laws of thermodynamics and the principles of modern astronomy are likewise wrong since they involve continuous and irreversible change in one direction. And apart from these philosophical and empirical objections, there are the more strictly mathematical ones.

If a vector is recurved upon itself to form a directed circle, the direction is not parallel to *XX* or *YY*, but is sometimes one and sometimes the other, and most of the time a combination of the two. If in the two-dimensional figure, one dimension stands out as of a different nature than the other, it is the direction of the tangent at any point, which is distinguished in kind from the normal. But the particular direction which is tangent varies as the circumferential point selected for reference varies.

Let us assume that this vector-circle represents a universe equivalent to ours, except that the number of dimensions is restricted. Then, the circle represents a world-line in a universe having time but no spacial dimensions, since no motion other than the temporal is possible. The tangent represents time, the normal represents a dimension of curvature whose existence would not be known to an individual living in the universe in question.

Consider next the surface of a sphere. To the external observer, there are three dimensions, but an observer within the system would be directly aware of only two. What are these two for him? Assume one to be spacial, one temporal. What distinguishes the spacial from the temporal? Absolutely nothing. If correctly stated, any law concerning this spherical surface must be equivalent in terms of the two dimensions. The third dimension will represent curvature, that is, the variation of the universe from that of a Euclidean plane.

The surface of a four-dimensional super-sphere would equally represent the universe of non-Euclidean Flatland; and the surface of a five-dimensional super-sphere would represent our own non-Euclidean universe. But this is possible only if the three-dimensions of space and one of time are actually indistinguishable, which is far from the case.

Let us then make a second attempt at analysis. The surface of a sphere is a surface in three-dimensional space, having at any

point, one dimension—that perpendicular (normal) to the surface —distinguished from the other two. Likewise the surface of a four-dimensional super-sphere has at any point one dimension naturally distinguished from the others by being normal to the surface at that point. Since our universe, as well as an imagined universe such as Flatland, has one dimension distinguished from the others, namely, time, while the others are indistinguishable amongst themselves, the normal must represent time.

But notice that, in this case, there is no previous or succeeding event at the same place, and the universe is certainly not ours. If we remove the restriction to the surface of the super-sphere, we get a four-dimensional (three space and one time) universe in which space-time approaches the Euclidean for any small section of it, which is finite and non-Euclidean (Lobatschefskian-type) at any given time, and expanding in time (it could be contracting as well). The idea of an expanding universe fits some observations of astronomy, but could not be correct unless every part of the universe, including objects on the earth, were expanding or tending to expand, as well. The hypothesis, therefore, fails to explain anything, and in any case would imply, at some time in the past (or future) the violation of all the laws of physics.

Abandoning this second method of representation, let us assume that a circle represents a universe of one spacial dimension, time not being represented. Then the surface of a sphere represents Lobatschefskian Flatland, and the surface of a four-dimensional super-sphere represents a three-dimensional non-Euclidean space. In all these cases, the time element is not represented, so that the arrangement of elements within the universes so represented changes with the passage of time.

If it is desired to represent time graphically, it will be as a line: if it is desired to combine the graphs of space and time, we will represent time as a dimension at right angles to the four spacial dimensions. The complete representation would be the five-dimensional figure produced by moving the surface of a four-dimensional super-sphere at right angles to itself; and the figure would be a five-dimensional super-cylinder whose axis is time, and in which any cross-section at right angles to the axis gives the surface of a four-dimensional super-sphere.

If we suppose, in addition, and despite the objection to that hypothesis, that time is recurved upon itself, time will be represented by a circle, and space-time as a six-dimensional figure produced by moving the surface of a four-dimensional super-sphere through a circle in two temporal dimensions, each perpendicular to the four spacial dimensions. This figure has no adequate ana-

logue; it bears certain resemblances to a doughnut, but is more correctly likened to a cylinder produced by moving a line through a circle.

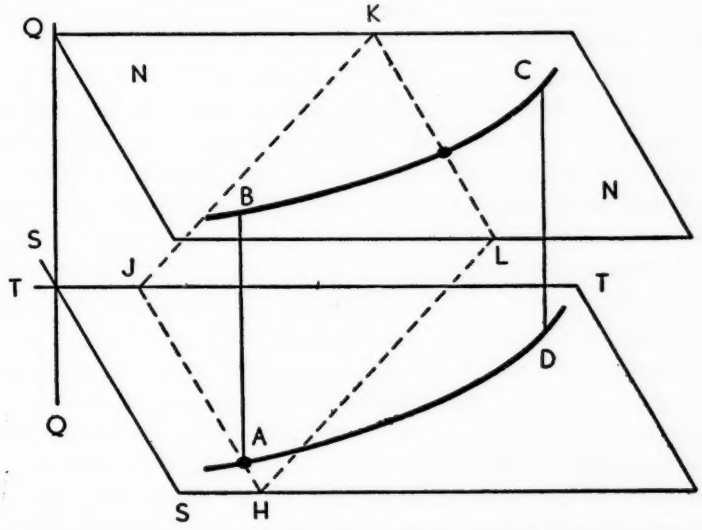
From the point of view expressed in the previous paragraphs, it is correct to represent time either as a dimension or as a curve in more than one dimension, provided that neither is taken to represent space. But in this connection there is a rather important caution: if it is assumed that this method of representation actually pictures a universe in which time and space are related as are two spacial dimensions upon graph paper, we will be in error. If, further, it is maintained that in such a universe time, as it is perceived by us, is produced by the motion of a three-dimensional spacial cross-section through a four-dimensional spacial continuum, we have an additional error. For the idea of motion involved in that conception, or equally the idea of successive presentation to our consciousnesses of the series of cross-sections, adds to the number of primitive concepts the concept of motion or successive presentation. This additional element is a new temporal one, and we find that we become involved in an unending recurrence of new temporal dimensions.

For example, let us examine the situation of a universe of one dimension, to be represented as a line, in which a single particle moves with ever-increasing velocity. Representing this universe diagrammatically we have a two-dimensional graph, in which one axis represents the spacial dimension, one the temporal, and in which the path of the particle is indicated by the curve *AD*. In so far as this diagram is meant to be a representation of such a universe, it is completely adequate; but when it is asserted in addition that the apparently one-dimensional universe is actually a two-dimensional universe, similar to that presented in the two-dimensional graph, in which the one-dimensional world moves (as by taking a line *JH* perpendicular to the *TT* axis and making it move along that axis at such a point), the diagram ceases to be adequate. For then the actual condition at any instant is this two-dimensional spacio-temporal universe plus the particular position of the line *JH*, and the history of the universe becomes the temporal succession of such conditions.

To represent this temporal succession graphically, we would have to use a third dimension which we may call real time (*QQ*). Any plane (*NN*) drawn perpendicular to the *Q* axis gives an intersection (*BC*) with the world surface (*ABCD*) of the particle. This intersection is the history of the particle. The plane *HJKL* represents the travelling present, and its intersection with *NN* is

the line *KL*, or the spacial world at the present. The intersection of *KL* with *BC* is the present position of the particle.

This three-dimensional graph adequately represents the present as moving through the spacio-temporal order, but again, if it is to be assumed that the present does actually move, then the universe at any instant is this three-dimensional universe with a plane of intersection at a particular point in the temporal dimension. We would then have a series of conditions in this third-dimensional universe that can adequately be represented only in four dimensions.



In every case, the interpretation of time as a spacial dimension in which the world moves requires an additional temporal dimension in which that motion may take place, so that no number of dimensions would ever be adequate to represent time in this sense.

The situation is entirely similar when we apply the same procedure to our own or any similar universe. If the universe with one temporal and three spacial dimensions be assumed to be really a four-dimensional continuum, then, analogously to the previous case, our experience is caused by the moving through that four-dimensional world of a three-dimensional cross-section representing our present. The succession of presents in which one particular cross-section is chosen above any others as representing "the" present requires the postulation of a new time for the succession; and when this new time is represented as a fifth dimension, still another time to account for the successive choice of four-dimensional cross-sections from this five-dimensional continuum. The process, of course, will continue to infinity.

Dunne,[1] curiously enough, proposes to accept an infinity of temporal dimensions and an infinity of observers, one for each dimension, intending, thereby, to solve the problem we have just been considering. These dimensions occur in regular order and may be referred to by the ordinal numbers, Time 1, Time 2, Time 3 up to Time ω. Dunne's ultimate observer is observer ω in Times 1, 2, . . . ω. However, the difficulties involved in the spacial interpretation of time persist for Time ω exactly as they do for any finite observer. Observer ω, moving through temporal dimensions 1 through ω, requires time $(\omega + 1)$ in which to move. The temporal series can no more come to an end than can the series of ordinal numbers itself.

But the question of the validity of a spacial conception or representation of time is more than a purely mathematical or representational one. It involves, as we explained at the beginning of this paper, not only the abstract question of representation, but also certain implications involving the laws of behavior within such a universe. At the simplest level we notice that any law should be equivalently expressed in terms of any one of the spacial or temporal dimensions, and if the temporal dimension is irreversible so also should be the spacial dimensions. But there are many laws which involve unilateral motion in time and none at all that involve the equivalent unilaterality of space. Immediately suggested in this connection is the second law of thermodynamics, laws of development in the astronomical field, biological evolution, and growth in the living organism. In fact, it might very well seem that a preferred direction for the temporal course of events is rather the rule than the exception. Under given circumstances, both physical and chemical laws normally express a single direction of development, irreversible as long as the environmental situation is not changed. Furthermore, there is some suggestion that in a given situation only one result may be produced, which result can therefore be infallibly predicted, but that the same situation may result from several possible sets of precedent causes.

If we go further and examine, not the temporal dimension alone, but the temporal dimension as related to the three spacial dimensions, we find that these dimensions are unique. Certain rules apply to a three-dimensional spacial cross-section of the universe which do not apply to a cross-section which involves the temporal dimension. In the first case, the laws of the indestructibility of matter

[1] This paragraph has been added subsequent to the writing of the rest of the article. My attention was called to J. W. Dunne's *An Experiment With Time* by Professor Montague who pointed out the similarity of the material in that work with the present article.

and of continuity of position apply. We have a world composed of discrete points, no matter what particular spacial cross-section is chosen. But a section involving time may give us some world lines as well as discrete points; and there is no apparent necessity why the number of such points should be assumed to be constant for any cross-section. That is to say, the amount of matter in the whole universe at any time (three spacial dimensions) is a constant, but the amount of matter found in any enduring plane (two spacial dimensions and time) need not exhibit any such constancy. To apply this consideration to the single particle we may say that the world line of the particle is uni-valued in terms of time. That is, the time value being given, the three spacial values are necessarily determined.

This is obviously not true of any spacial dimension. The distance of a particle from a given axis is a value which may occur many times and may be associated with an unlimited number of values in the other three dimensions. It is conceivable as well that there may be a certain value of the spacial element X for which no values for Y, Z, and T, can be found to satisfy the equation of the world-line.

As against the statement of the previous paragraph, it must be observed that speculation in modern physics has sometimes produced the concept that the temporal dimension is relative to the observer; that, in fact, the particular direction selected as the temporal dimension will depend upon the state of rest or motion of the observer, and that two observers moving relatively to each other will have different temporal dimensions.

Although on the face of it this theory would seem to contradict the arguments suggested in this article, it may be apparent on further investigation that no such contradiction is involved. For the tilting of the axes postulated in all such relativistic theories is always limited in amount, so that a cone can be drawn from any point of origin, including within the cone all possible temporal directions, and such that no line within the cone can seem to any observer to be a spacial line. In the same way a line lying outside the cone itself would appear to any observer as a spacial line, and any line on the cone would appear as a light line. Thus the relativity as applied to time is relativity which does not in any way confuse the spacial and temporal, but allows any line to maintain its particular spacial or temporal nature regardless of any choice of observers.

Reviewing, then, the arguments of this paper, we reach the following conclusions:

A. Our space is three-dimensional.

B. It may or may not be Euclidean. If not Euclidean it may be represented as a three-dimensional surface in a Euclidean space of more than three-dimensions. The number of dimensions necessary for this representation depends upon the particular way in which space behaves, but it is commonly assumed that four is sufficient.

C. It is impossible to tell whether the four or more dimensional Euclidean continuum has real existence or is merely a conceptual method of treating real non-Euclidean space. Evidently no empirical evidence can ever be brought to bear upon this matter. But if the question has any meaning, which is itself doubtful, it might be solved in accordance with Occam's principle, leaving the world three-dimensional.

D. Whether real or conceptual, the fourth dimension is not a new dimension added to the other three, but the four taken together define the same space otherwise expressed as three-dimensional. Hence, all four dimensions are spacial.

E. Time is not analogous to a spacial dimension.

F. Time and space may be represented in the same diagram, time as one or more dimensions, space as three or more: but if any line is made to represent either space or time at will, inconsistencies will develop.

G. There is reason to deny, and no reason to believe, that time is recurved upon itself. But if it is, and the curvature is represented in a second dimension, the two dimensions taken together are time, and both are of a temporal, non-spacial nature.

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THE PRINCIPLE OF INDUCTION AND *A PRIORI*

IN the course of his discussion on cause and effect, Hume proposed and then, perhaps possessed by a sense of futility, almost immediately dismissed the problem whether we have any assurance of the future's resembling the past. The problem does seem insoluble. Mr. Russell, I believe, has somewhere pointed out that the principle of induction can not be inductively derived, since any attempt at deriving it through induction obviously assumes the principle. It is suspected that the same may be said of the problem of the resemblance of the future to the past; if we assume the resemblance we can always substantiate it, but we can not substantiate it without assuming it, and no amount of substantiation will give us

any assurance. In the following discussion I shall give reasons for believing that the supposed problem is hardly a problem, that we do have assurance, but that the assurance we have is *a priori* in nature though different from a tautology.

I shall take for the purpose of discussion the principle of induction as formulated by Mr. Russell: "If in a large number of instances a thing of one kind is associated in a certain way with a thing of another kind, it is probable that a thing of the first kind is always similarly associated with a thing of the second kind; and as the number of instances increases, the probability approaches almost to certainty." Not having a single book on hand,[1] I can not vouch for the correctness of the above quotation, nor will I say anything as to whether or not it is an adequate formulation of a weighty principle.

I shall also leave untouched the problem of probability, important though it is, and devote myself entirely to the principle itself and to the Humean problem of whether or not the future will resemble the past. We may reason that if the future does not resemble the past, then no matter how many instances there are of a certain kind of association, there is no probability of its being continued beyond those given instances. The probability does not refer directly to the generality of a certain association; it refers rather to a representativity of the general which the given instances supply under the assumption that there are general associations persisting through time and space. From the point of view of this article, at any rate, the problem of probability is secondary to the problem whether or not the future will resemble the past.

I shall illustrate the above principle by designating by "a" and "b" things or particulars, by "A" and "B" kinds of things and by "———" whatever association is experienced:

If

$$\begin{array}{c} at_1 \text{———} bt_1 \\ at_2 \text{———} bt_2 \\ \vdots \qquad\quad \vdots \\ at_n \text{———} bt_n \\ \hline A \text{———} B \end{array}$$

then

The a's and b's, being particular objects or events, either are or take place in particular places and times. We ignore the problem of space in this article. Time is symbolized by adding t_1, t_2, t_3, $\cdots t_n$ to the a's and b's. A and B being kinds of things, A———B is therefore the generalization aimed at by induction.

[1] Professor Chin's university had moved 3000 miles overland from Peiping to the Southwest and was functioning without adequate library facilities. Ed. Note.

The problem whether or not the future resembles the past is supposed to be crucially tested by the contingency of at_{n+1} being similarly associated or not with bt_{n+1}. It is easily supposed that if at_{n+1} is not so associated with bt_{n+1}, then A———B does not hold and the future disagrees with the past. It is true that under the circumstances, A———B does not hold, but it by no means follows that the future does not resemble the past. Although when a generalization holds, the principle of induction succeeds, it does not fail with the failure of a generalization. The problem whether or not the future resembles the past is always resolved into the question of the present or the past agreeing or disagreeing with itself. The following considerations will, I hope, make the points involved clear.

To start with, since A———B is meant to be general, it obviously could not be treated as a particular in any way. But we are liable to reason in the following manner:

$$\begin{array}{c} at_1 \text{———} bt_1 \\ at_2 \text{———} bt_2 \\ \vdots \qquad\quad \vdots \\ at_n \text{———} bt_n \\ \hline A \text{———} B \\ \hline at_{n+1} \text{———} bt_{n+1} \end{array}$$

If we proceed in this way, we should be treating A———B as a summary at t_n of instances up to t_n. Although it is not itself an instance, it is still a particular proposition which is assumed to be true of the a's and b's from t_1 to t_n. This proposition, if true, is true forever after, no matter how at_{n+1} and bt_{n+1} are to be associated. No matter what the future is, even if we assume it to be entirely different from the past, A———B is not thus invalidated. Under the above suppositions, the agreement or disagreement of the future with the past is merely an agreement or disagreement of any instance after t_n with the instances before, including t_n. If there is agreement, well and good; if there is not, we may even have to say that after all history does not repeat itself.

The kind of agreement or disagreement which is not just a question of history is the kind where at_{n+1} and bt_{n+1} not merely agree or disagree with the previous instances, but also substantiate or invalidate A———B. But at_{n+1} and bt_{n+1} can affect A———B only when the latter is not merely a summary at t_n of instances from t_1 to t_n, but also a generalization meant for any instance whatever including at_{n+1} and bt_{n+1}; that is, when A———B is meant to

be general. When A———B is so meant, we have to proceed in the following way:

Either at_1———bt_1 or at_1———bt_1
at_2———bt_2 at_2———bt_2
⋮ ⋮ ⋮ ⋮
at_n———bt_n at_n———bt_n
at_{n+1}———bt_{n+1} at_{n+1} bt_{n+1}
A———B A B

depending on whether the fresh instance is positive or negative. The agreement of the fresh instance with the previous instances adds to the force of the generalization, while the disagreement invalidates it. But does this mean that the future agrees or disagrees with the past? The above tabulation probably makes it evident that the question must be answered in the negative. However, we shall refrain from any such conclusion for the moment, since we have been discussing merely the generality of A———B, and have not even touched upon the problem of time and the relation between the enumeration of instances and the generalization. The principle of induction is formulated in terms of the if-then relation. Now take any case of "If p, then q." Where p and q represent tautologies, or natural laws, or empirical generalizations, there is no question of time either in the validity or in the assertion of the if-then relation, although of course time may enter as an element in p or q. Where p and q both represent particular propositions, the problem of time may be extremely complex, at any rate we shall ignore it here. But where p is in time while q is timeless, the validity of "if p then q" may or may not be timeless, the assertion of it involves time as a potent factor. The principle of induction, as formulated by Mr. Russell, summarizes all the instances in the antecedent and embodies the generalization in the consequent. Whether the principle is always valid or not (we shall take up the problem later), the assertion of it in connection with any specific case of induction must include all the known or the experienced evidences gathered *up to and* at the time of the assertion; that is, the assertion of this principle in the case of the a's and b's as evidences for A———B must include the last evidence relative to the time when the assertion is made. Thus at t_n we have

if at_1———bt_1
at_2———bt_2
⋮ ⋮
at_n———bt_n
then A———B

while at t_{n+1}, we have

$$\begin{array}{ll} \text{if} & \begin{array}{cc} at_1 & \text{———} & bt_1 \\ at_2 & \text{———} & bt_2 \\ \vdots & & \vdots \\ at_n & \text{———} & bt_n \\ at_{n+1} & \text{———} & bt_{n+1} \end{array} \\ \hline \text{then} & A \text{———} B \end{array}$$

From this one could readily see that no fresh instance of a and b ever gets below the horizontal line which is the symbol for the summary up to the present. While it is true that at t_n any possible at_{n+1} and bt_{n+1} in future may or may not agree with the previous instances, yet at no time could the future agree or disagree with the past. We must distinguish the present from t_n as well as the future from t_{n+1}. The present and the future are variables while t_n and t_{n+1} are particular values for these variables. The present never stops, but t_n is fixed forever. With this distinction in mind, we can easily see that by the time that at_{n+1} and bt_{n+1} agree with the previous instances, the present has moved from t_n to t_{n+1}; viz., it is no longer a future instance. It isn't the future that is agreeing with the past, it is at_{n+1} and bt_{n+1} agreeing with the previous instances.

When we have a positive instance such as at_{n+1}———bt_{n+1}, the generalization A———B is strengthened at least by the additional force of one more instance, but this does not mean that the principle of induction is also strengthened. If the principle were strengthened by a positive instance, it should be weakened by a negative instance, but it isn't. Supposing we are confronted with a negative instance, we have something like the following:

$$\begin{array}{ll} \text{since} & \begin{array}{cc} at_1 & \text{———} & bt_1 \\ at_2 & \text{———} & bt_2 \\ \vdots & & \vdots \\ at_n & \text{———} & bt_n \\ at_{n+1} & & bt_{n+1} \end{array} \\ \hline \therefore & A \qquad B \end{array}$$

which is an instance of an implication with the above enumeration of instances as the antecedent and the above generalization as the consequent.

It is true that in the face of a negative instance, the generalization A———B does not hold, but then we can easily see that the data gathered are not such as to satisfy the condition for a positive

generalization required by the principal of induction, which remains therefore unaffected. It is again no longer the future differing from the past, it is at_{n+1} and bt_{n+1} disagreeing with the previous instances. In fact not only is the principle of induction unaffected, but also by making use of it together with other principles some kind of generalization other than the negative of A———B could be obtained from the above data.

It is now presumably clear that the success or failure of a generalization does not entail a corresponding success or failure of the principle of induction, and the agreement or disagreement of one instance with the previous instances does not entail a corresponding agreement or disagreement of the future with the past. On what evidence then does the principle rest? What assurance have we for the validity of the principle? We shall see that the problem of the future resembling the past is the same problem as the validity of the principle of induction. In order to tackle the problem we have to remind ourselves of the relation "if-then" in connection with time. Time is a passage, a flow, while the if-then relation in the principle of induction is, let us say, a cross-section, and no matter how time may flow, this relation cuts across it. But in doing so, the contents of the antecedent and the truth value of the consequent may have been changed in any specific induction. Let p stand for any specific antecedent, and q its consequent. As time moves forward the content of p changes and with it possibly also the truth value of q. The above illustration of both a positive and a negative instance already exhibits this point: while both change the content of p, a positive instance leaves the truth value of q unchanged, while a negative instance alters the truth value of q.

Thus, with regard to any specific induction, time supplies fresh instances only to change the content of antecedent and possibly also the truth value of the consequent, but in doing so, the truth value of the principle remains unaffected. It remains unaffected partly because any specific induction is only a value for the principle, which means that different values may be substituted but the form of the principle remains; and partly because the consequent is so automatically adjusted to the antecedent that the if-then relation between them has always the same truth value no matter at what time. But having a constant truth value is not the same as being always valid. A false proposition also has a constant truth value. We have to analyze further in order to show that the principle is always valid.

Let us take up the generalization A———B. It is of the form

(1) $$(a,b)\varphi(a,b)$$

and since we ignore the problem of space it is by definition equivalent to

$$(2) \qquad \varphi(at_1,bt_1)\cdot\varphi(at_2,bt_2)\cdot\ldots\cdot\varphi(at_n,bt_n)\cdot\ldots\cdot\varphi(at_\infty,bt_\infty)$$

Now the antecedent of the principle of induction which is a summary of instances at any time t_n is only

$$(3) \qquad \varphi(at_1,bt_1)\cdot\varphi(at_2,bt_2)\cdot\ldots\cdot\varphi(at_n,bt_n)$$

This is obviously incomplete and is never the equivalent of (2). But although (3) is never the equivalent of (2) it is also never such that (1) is false. No matter how many positive instances are added (3) will retain the same form. That is to say, "if (3) is true, (1) is true" can always be asserted. Time however may bring forward a negative instance the presence of which changes (3) into

$$(4) \qquad \varphi(at_1,bt_1)\cdot\varphi(at_2,bt_2)\cdot\ldots\cdot\varphi(at_n,bt_n)\cdot\sim\varphi(at_{n+1},bt_{n+1})$$

Now (4) is equivalent to

$$(5) \qquad \sim(a,b)\varphi(a,b)$$

Hence, "If (4) is true, (5) is true" always holds; that is what is meant by saying that a negative instance is conclusive. The implication between (4) and (5) is both deductive and inductive; it is deductive because pure logic guarantees its validity, and it is inductive because (5) the consequent as a generalization follows from the presentation of an actual instance. It is true that at t_n we do not know that a possible instance at t_{n+1} is to be positive, or that it is to be negative, but we do know that it is either positive or negative, and whether it is actually positive or actually negative, it enters into the antecedent, and the consequent is also either positive or negative. In either case, (3) implies (1) or (4) implies (5), and whichever the case may be, the principle of induction holds.

The principle of induction therefore would not be invalid, neither will the future, if there is any, upset the past. The past and the present are differentiated, integrated, and catalogued like the books in a library which are marked one way or another. They are mere aggregate names for so many broken-up experiences which are labelled sometimes accurately and sometimes haphazardly by the enormous number of concepts with which we face whatever is given. The moment the future enters into the present, it loses its lumpiness, and if it does not fall in the line we expect it to, we may be disappointed, but we shall soon find that it falls in line with something else, or if it doesn't fit in with anything whatever, it will merely enrich the past and the present with a new category: one thing that it does not do is to upset the past. It will not, because the

moment we can say something definite about it, it ceases to be lumpy and becomes itself a part of the differentiated and catalogued past and present. The line of argument here taken is analogous to that maintained by C. I. Lewis. Our concepts are prescriptive not in the sense of determining what the future is to be, but in the sense of how it is to be received; and however it may come, we have assurance of receiving it one way or another. Take, for instance, our attitude toward any possible instance of a, b, at t_{n+1}. In the first place, it is said to be either positive or negative. We may argue that this says nothing, but we have to admit at the same time that conceptually though perhaps not psychologically we are ready for anything. Supposing that an established generalization in the past has been invalidated, we merely say that the generalization has never been true. The supposed generalization suffers indeed, but not the past. Furthermore, the new instance upon closer examination either baffles us or does not; if it does, it is in the process of furnishing us with new concepts; if it does not, that amounts to saying that our conceptual instruments in stock are capable of dealing with it.

The principle of induction is *a priori*, it is valid for any time. The notion of *a priori* here is not that of any transcendental form by means of which experience is made possible, rather is it a form which is valid for any experience; its origin does not involve a transcendental mind, and our awareness of it is not prior to any experience whatever. From what has been said above, the principle of induction, being true of any experience, is an *a priori* principle. Mr. Russell has somewhere suggested that this principle is *a priori* because it is not and can not be inductively derived. This merely says, however, that any induction assumes the principle and to derive it through induction is to assume it in order that it may be derived; this does not show that the principle is *a priori* in the sense here accepted. In order that the principle may be shown to be *a priori*, we have to show that it is valid for any time, or, with reference to the future, the future can not do anything to upset it. And this, I hope, has been accomplished by the previous paragraphs.

Suppose, however, that time stops with some disembodied intelligence still functioning. This may be unimaginable, but it is eminently conceivable. Experience in our sense discontinues but some lumpy state of affairs remains. Tautologies are still valid, they assert no possibility as a fact and every possibility as a possibility, and any state of affairs that is at all conceivable must be within the realm of possibilities. In fact, to say that a certain state of affairs is conceivable means that it is something for which

tautologies hold, for if it were something for which tautologies do not hold, it is automatically inconceivable. I shall not discuss the problem whether logic is one or many. I myself believe that there is only one logic. Suppose for the moment, however, that there are many logics. Obviously one can not invoke all of them at the same time, and if one is used, this one becomes the limit as well as the tool of conceivability. One way or the other, therefore, we may conceive a timeless and lumpy state of affairs in place of our present world. With the stoppage of time, there is also no motion, no life, perhaps also no space, no distinction of this and that, neither particular nor individual; all former distinctions are obscured and universals become empty possibilities. Will the principle of induction hold in such a state of affairs?

To take the obvious point first, the principle will be entirely useless. The disembodied intelligence will see that its usefulness depends upon the differentiation through time of what is given into categories; when time stops, no differentiation takes place, consequently there are also no more *a*'s and *b*'s. Furthermore, *A*———*B* which was meant to be general in the form given in (2) above can no longer be so regarded; with the stoppage of time, it ceases also to be a natural law, it becomes at most a brief summary of historical facts of the form such as for instance "The ancient Greeks were athletes." This might be interesting to the disembodied intelligence as a historian, but not if he were a philosopher or a scientist. The principle seems to be plainly useless. But admitting that it is useless in such a state of affairs is far from saying that it is invalid. Under such circumstances a tautology is also useless but it is none the less valid. If we suggest that the principle of induction is no longer valid, we have to give more reasons.

Let us remind ourselves that a tautology is valid at any rate partly because it says nothing, it does not assert the existence of a lumpy state of affairs, or describe what it is like; it is valid for such a state quite as uncommittedly as it is true of our present world. The principle of induction, however, is not a tautology, it does say something. Although it is not identified with any specific induction which may be concerned with the objects of inquiry in any specific field, it yet assumes the existence of particular instances, the subsistence of general relations, the subsumption of particulars under universals; and in assuming that the universals with which it deals are not empty possibilities, but are realized in terms of orderly instances, it assumes a world differentiated into the scaffolding of time and space. What it asserts is therefore entirely nullified by the supposed timeless and lumpy state of affairs, for the

antecedent which is a summary of instances is still true, but the consequent is false, since with the stoppage of time, there are no natural laws of the kind meant.

It must now be understood that with the elimination of time there are no natural laws. A genuine natural law has to have differentiated physical meaning. In a timeless and lumpy state of affairs, general relations may have both mathematical and metaphysical meaning, but no differentiated physical meaning. They may have mathematical meaning, because all the concepts involved in them may be organized into a deductive system in which these relations enter as theorems. They may have metaphysical meaning in the sense that the said state of affairs may be regarded as a whole in which all attributes are reconciled in a Bradleyian sort of way. But they have no differentiated physical meaning, since the lumpy world is not supposed to furnish us with instances, either observational or experimental, upon which the physical meaning of genuine natural laws must be based.

But, no matter how conceivable our supposition is, it is something such that no positive reason, no reason other than that of pure logic, can be given in favor of its ever taking place. Time won't be annihilated, it is the very core of that givenness, that stubbornness, that concreteness, that basis for factuality which pure logic does not provide for, but which is yet what the world is made of. There is therefore always future. So long as there is a moving future, there is always a living present and a past which can not be upset because whatever is presented will be received one way or another. The conceptual reception of the given is epistemological experience, and the principle of induction is a principle of reception. So long as time supplies us with something to be received, the principle of induction will be valid. It is an *a priori* principle, but of a kind different from a tautology.

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BOOK REVIEWS

The Social Mind. Foundations of Social Philosophy. JOHN ELOF BOODIN. New York: The Macmillan Company. xi + 593 pp.

Though this work is, as its subtitle announces, an essay on "the foundations of social philosophy," it is also a contribution to the philosophy of mind. Its basic thesis is that the theories of mind and of society are inseparable. Following Royce's analysis of

"the community of interpretation" Boodin explains how the interpenetration of minds in society may be regarded as a "creative synthesis" which emerges in the course of evolution as one of the *Gestalten* in the cosmic "whole-making" process.

Taking the organization of minds in its social, rather than its cosmic, matrix, and following the course of experience, his account appears to fall into two different accounts. In one he begins with the fact of social participation which makes the group and the social mind primary and explains how out of a socially standardized pattern of life which "automatically" controls its members there arise successively "dogmatic," then "critical" and "creative," standards. In the other he begins with impulsive individuals, guided more by feeling than by will and shows how they gradually are organized by the "steady pressure of conation" into characters capable of consistent achievement and a "unification of values." In the one case creative critics emerge from a uniform social matrix; in the other, a unified society emerges from the rational "canalizing" of the rudimentary capacities of individuals. These two accounts, which will be recognized as the positivistic and the idealistic theories of society and morals, are not necessarily contradictory and Boodin's work suggests how they can be reconciled, but they are not yet worked together into a single system. Such a naturalistic idealism, as one might call it, is evidently Boodin's aim, but it is not completely realized.

The difference between the two theories is most conspicuous when they are applied to the problem of the evolution of the social mind. Boodin regards evolution as a "whole-making" process; but is it not also a whole-breaking process? Groups are made and unmade in the course of natural history and there is more hope than evidence in favor of the emergence of ever larger wholes. The issue is sharpened by Boodin's treatment of mysticism. Since he regards any natural whole as a "creative synthesis" he interprets the primitive conception of social participation as the recognition of a fact. He is willing to call primitive participation "mysticism," following Lévy-Bruhl, but he sees nothing a-logical in it; it is the mind's discovery of the essentially social matrix of human experience. Later on in the volume, however, mysticism appears as the highest level of interpretation, emerging above the levels of perceptual and conceptual interpretation and implying an "intuitive element of faith and the sense of reality."

> There is here, especially on the highest stage, that of ideal interpretation, a peculiar sense of prevision, a feeling for unity and harmony in time which far outstrips our actual generalizations. It is a massive forward-looking feeling for unity at each moment of knowledge, a sense of convergence and

wholeness, which guides our search for truth. Though the realization is finite, yet in each moment the sense of convergence, of blending or fusion, has a different significance. As the process itself is a growing process, this ideal can never be realized. The future somehow casts its shadow behind, the time-form directs the process, or rather the mind divines, feels into, the beyond, toward a complete ideal. [P. 351.]

In other words mysticism is at once a realistic sense of the natural conditions of interpretation and also an anticipation of the ideal. It reflects the ambivalence of the term "reality" as this term is used in idealistic metaphysics.

The real measure of progress for Boodin seems to be the transformation of external controls and meanings into internal. This doctrine is given an interesting application in his analysis of the "moral neighborhood." Civic society, as contrasted with instinctive or habitual society, is a product of intelligence. (Here he is anti-Bergson.) The first fruit of social intelligence is the recognition of "reciprocity" as the rule governing social relations. In its external application the rule of reciprocity is the reign of law. But as this "moral" control eats its way into the social mind and becomes an inner control, political government gives way to "moral neighborhood." Such a neighborhood is one whose members most fully interpret each other and govern themselves in the light of these interpretations.

Once we realize the reality of the community, the cooperative relationship of human beings with their clashing, overlapping interests, and live ourselves into the tissue of life of our neighborhood as a moral and not merely an external relationship, then culture shall come to have new reality and meaning. [Pp. 471–472.]

The unit of personal relations and the unit of political control never have coincided nor can they at best wholly coincide. A unit which is large and complex enough to furnish a substantial basis for independent political organization must necessarily be too large for intimate personal association. Our memory and imagination, as well as our moral capacity for helpfulness, are limited. A political unit, moreover, must include all varieties and conditions of men with their division of labor and variety of interest. . . . While in our modern democracies we may look for a more wide-spread interest in culture, the actual cooperation in cultural production must naturally be limited to small groups. What we can hope is that the unit of political control shall further the means of cultural cooperation and, by the atmosphere which it can create, stimulate instead of thwart the creative spirit. The creative cultural group is necessarily selective and should include those gifted by nature, training and nobility of aim to cooperate in a creative purpose. The best results for culture seem to be produced in friendship groups such as the Pythagorean fraternity, the Socratic group and Plato's Academy in ancient times, and the masonic guilds that built the Gothic cathedrals toward the end of the Middle Ages. There should be the widest tolerance of differences in viewpoint and the greatest desire on the part of each participant to furnish his creative

increment in the erection of the temple of truth and beauty. Such masonry of the spirit has always been rare. [P. 473.]

This "masonry of the spirit" marks the culmination of Boodin's social philosophy. It is significant that the "cultural" communities are quite distinct from, and to a degree even antithetical to, political communities. Societies in the full sense of "communities of interpretation" are necessarily neighborhoods—finite, intimate, and personal. It is in such communities that Boodin finds a genuine solution to Royce's problem of the individual in society. In place of Royce's infinite society, presided over by the absolute spirit of community, Boodin presents us with individualized societies, communities functioning as moral individuals in a larger, more external social matrix. The question still haunts us: Are these "units of civilization" the end products of a cosmic "whole-making" process, or are they the inventions of civilized social minds?

HERBERT W. SCHNEIDER

BOOK NOTES

On Hegel's Critique of Kant. JOSEPH MAIER. New York: Columbia University Press. 1939. viii + 108 pp. $1.50.

This brief compact volume brings together from widely scattered sources much interesting material bearing upon Hegel's relation to Kant. It falls into three parts. The first describes the young Hegel's brief espousal of the Kantian philosophy and his passing enthusiasm for the ideas of the French Revolution. The author shows that "the more Hegel adopted the Kantian philosophy as his own, the stronger became his criticism of the present; the more he adopted the ideas of 1789, the more concrete and practical became his conception of *Volks-religion.*" The second part of the book describes Hegel's monumental program to overcome the dualism and formalism of Kant, while the third part attempts to prove that this program was a failure, that the dualism and formalism remained, that the relentless dialectic arbitrarily expires in Hegel's own philosophy and in the Prussian state, that Hegel's naturalistic theory of the origin of the state turns into an irrational defense of hereditary monarchy, while his theory of freedom becomes in practice apologetics for any tyranny which may turn up in history. In his criticism of Hegel's idealistic and formalistic dialectic the author follows, for the most part, the trenchant arguments of Feuerbach and Marx, and the long quotations from the latter as

explained in the text impart strength to this chapter. At times, however, the criticism goes too far. When the author states that "the Hegelian philosophy of history allows no real passage from the present to the future, . . . it transforms a dynamic dialectic into a static metaphysic," one is reminded that, with all his shortcomings and ambiguities, Hegel was the first, and his followers, the last, to grant reality its historical nature.

Dr. Maier has done well to focus his scholarship upon a problem of such general interest. The relation of Hegel to Kant, already illuminated by an extensive but scattered literature, receives a new clarification in his book.

V. J. McG.

The Early Reading of Pierre Bayle. Its Relation to his Intellectual Development up to the Beginning of Publication of the *Nouvelles de la republique des lettres.* RUTH ELIZABETH COWDRICK. New York: Privately printed. 1939. 216 pp.

This dissertation concentrates what seems like a disproportionate amount of effort on a narrowly limited subject, the books read by Bayle between 1670 and 1684, in the belief that existing biographies have taken "too little account of his mental development in the impressionable years of his youth and early manhood." Although the author finds that "the really significant evolution of Bayle's thought [during those years] took place in the fields of philosophy and religion," it can not be said that her two chapters on Bayle's philosophical reading bulk very impressively in comparison with her five chapters on his religious wanderings. His "scepticism in philosophy apparently began earlier and developed less gradually than his religious scepticism" and extended by 1676 to "the tenets of all philosophical sects." Miss Cowdrick provides a "List of Writings Mentioned in Bayle's Correspondence" in the years above-mentioned. Even a rapid perusal of it will convince anyone that her observation that Bayle had "an unusually bookish mind" is something of an understatement.

H. A. L.

The Nyāya Theory of Knowledge. A Critical Study of Some Problems of Logic and Metaphysics. S. C. CHATTERJEE. Calcutta: University of Calcutta. 1939. xix + 421 pp.

With the sympathetic thoroughness and precision characteristic of the best Hindu scholarship, Dr. Chatterjee of Calcutta University expounds the classic pluralistic realism of India. The

period covered is from the *Nyāya-Sūtra* of Gautama to the syncretic works of Annaṅ Bhaṭṭa and Viśvanātha. The treatment is analytic, comparative, and critical, the epistemological and logical doctrines of Nyāya-Vaiśeṣika being studied in relation to those of recent Western philosophy (chiefly British), as well as to those of the Buddhist, Jain, Sāṅkhya-Yoga, and Vedānta positions. The body of the book is devoted to knowledge and its "methods": perception, inference, comparison, and testimony. To these four ways or sources of knowing recognized by the Nyāya view, the author would add three others: memory, non-perception, and postulation.

According to Nyāya, knowledge is not an act or relation but a quality, a property of the immaterial substance called soul. Only objects can act. When the soul knows (through association with body), it merely points to an object with "intentional inexistence." As Reid says, "knowledge is not itself a relation but the apprehension of relations." But the Nyāya theory, the author contends, fails to account for objective reference, since quality is intransitive.

Dr. Chatterjee concludes, with Bosanquet, that knowledge is self-expression. "Then we must give up the Nyāya theory of the individual self as a substance which is not essentially conscious . . . we must give up the idea of an ultimate dualism . . . between subject and object, mind and matter"; for the common-sense distinction between subject and object is only relative and presupposes a ground-self which makes it. But this conclusion of the author may be criticized as accepting two subjects—the ground-subject and the mind-subject. It is simpler to hold that only the ground-subject exists. The mind-subject of common sense would then be merely an organism, a structure among structures, an appearance of the ground-subject. Mind could then be conceived functionally as the distinguishing and relating process through which the one subject expresses itself as many structures. *Knowledge,* then, would be the material and final self, both subject and object; and the activity or self-expression of this knowledge could be called *knowing.*

WENDELL THOMAS.

NEW YORK CITY.

Art is Action. A Discussion of Nine Arts in a Modern World. BAKER BROWNELL. New York: Harper and Brothers. 1939. vi + 231 pp. $2.00.

This book is not addressed, one gathers, to philosophers or artists, or even to students of the arts. It is directed rather at those whom the author thinks would profit in delight by an ac-

quaintance with the arts and a realization that "Art is Action," "immediate in value." Perhaps so. But one wonders just who is going to be helped to understand "art" or the arts by such dicta as "But life has dynamic multiplicity."

"In any case play, love, art, laughter, [and] religion are alike" (p. 35). Such a grand blur of distinctions does not help us to know or understand. But then that does not seem exactly Mr. Brownell's purpose. "We should," he says, "approach art . . . not as something to know but something to do, not as something to think out but as something to participate in" (p. 33). His other most characteristic summary statement about the arts (p. 218) is: "The integrity of life, wherein activity is at once producing and consuming, or enjoyable, in function, has been lost as a natural and expressive rhythm. It must now be acquired, if at all, by *deliberate effort and consideration,* namely, by art" (italics the reviewer's). But art, one has been told, must not be thought out, and it is identical (or is it?) with the spontaneities of laughter and love.

Of the particular arts, there is nothing new or important or even very refreshing said, except perhaps of the art of cooking, for the first time raised to almost metaphysical consideration.

> More recently a movement, which may be termed neo-classic cooking, has gained strength. Science has been summoned and the functional values of the art considered. Chemistry, calories and withal a good deal of common sense characterize this school. It is classically objective, cool. It returns to fundamentals. . . . It is as sound and tempered, and as wholesome, as a prelude by Bach. In the art of the dance of Isadora Duncan, in architecture, in machine design, and in cooking America has become the modern representative of the classic temper. [P. 109.]

Gone the "dissonance of acids," of the "romantic movement in cooking" where "every restaurant had its Debussy." The next chapter is on poetry, "not so great a step as it may seem."

With Mr. Brownell's attempt to distinguish art as action from art as symbolic (of indirect experience), with his setting of art as action as superior because there is no "thinking" in it, this reviewer grows, to put it mildly, confused.

Of his introductory statement (to which deliberate reference was made after a careful reading of the book), this reader can make very little. Art "has form, but the content and action of it are more important." And what are these three things? The book does not make clear. It would be a more important book if it did.

I. E.

Three Copernican Treatises. The Commentariolus *of Copernicus, the* Letter against Werner, *the* Narratio Prima *of Rheticus.* Translated with Introduction and Notes by EDWARD ROSEN. (Records of Civilization Sources of Studies XXX.) New York: Columbia University Press. 1939. x + 211 pp. $3.00.

Students of the history of thought will be permanently indebted to Dr. Rosen for making available for the first time in English these important scientific treatises of the sixteenth century. The texts, excellently annotated, supply authentic material for appraising the intellectual temper and the intellectual methods of some of the men who have made modern science possible. They reveal impressively the inspiration which Greek thought held for the great pioneering minds of the Renaissance, and they exhibit once more the extent to which their thought was dominated by a mixture of mathematical rigor and pious superstition.

Dr. Rosen's illuminating Introduction supplies all the information necessary for understanding the assumptions and innovations of the Copernican astronomy; it also includes concise accounts of the lives of Copernicus and Rheticus and of the occasions for which the present treatises were written. Of special interest is Dr. Rosen's discussion of Copernicus's views on hypotheses in astronomy, which were required not only "to save the appearances," but also to be consistent with certain "axioms of physics" (such as that every celestial motion is circular). In this connection Dr. Rosen examines the view advanced by Osiander (in the latter's anonymous preface to the first edition of the *De Revolutionibus*) that the hypothesis of the earth's motion was nothing more than a basis for calculation, which was adequate if it succeeded in saving the appearances. Dr. Rosen argues convincingly that Copernicus did not share this opinion, but that on the contrary he believed this hypothesis to represent a physical reality. Osiander apparently advanced his interpretation as a practical expedient for circumventing the hostility of philosophers and theologians. One would like to know, however, where he obtained this "fictional" view of mathematical physics, and to what extent his ideas were shared by his scientific contemporaries.

It is to be hoped that Dr. Rosen will succeed in publishing in English the *De Revolutionibus,* in time for the approaching quatercentenary of its first publication in 1543.

E. N.

OTHER NEW BOOKS AND JOURNALS

Hilgard, Ernest R., and Marquis, Donald G.: Conditioning and Learning. (Century Psychology Series.) New York: D. Appleton-Century Company. 1940. xi + 429 pp. $2.75.

Braghine, A.: The Shadow of Atlantis. New York: E. P. Dutton & Co., Inc. 1940. 288 pp. $3.50.

Dare, M. Paul: Indian Underworld. A First-hand Account of Hindu Saints, Sorcerers, and Superstitions. New York: E. P. Dutton & Co., Inc. 1940. 218 pp. $2.50.

We print below a list of selected articles from the following publications:

JOURNAL OF SOCIAL PHILOSOPHY. Volume Five, Number Two. The Superpolitical: *R. G. Tugwell.* The Juristic Thought of Mr. Justice Frankfurter: *M. J. Aronson.*

THE HIBBERT JOURNAL. Vol. XXXVIII, No. 2. The Irrelevance of Natural Theology to the Christian Religion: *J. D. Smart.* The Will in Buddhism: *Mrs. Rhys Davids.* Space-Time: A Link between Religion and Science: *Richard Tute.*

HARVARD THEOLOGICAL REVIEW. Volume XXXIII, Number 1. The Origin of Belief among the Greeks in the Divinity of the Heavenly Bodies: *M. P. Nilsson.* The Contribution of *Existenz-Philosophie: J. S. Bixler.*

THE NEW SCHOLASTICISM. Vol. XIV, No. 1. The Philosophy of Beauty in the Enneads of Plotinus: *Sister Rose Emmanuella Brennan.*

ALLAHABAD UNIVERSITY PHILOSOPHY ASSOCIATION BULLETIN. Number Two. Philosophy and Social Reconstruction: *I. S. Singhal.* Philosophy and Social Reconstruction: *H. R. Thakkar.* Virtue is Knowledge: its Influence on Greek Philosophy: *Indra M. Sinha.* Can Conscience be Taken as the Ultimate Standard of Moral Judgments? *Chandra Dhar Sharma.*

JEWISH SOCIAL STUDIES. Volume II, Number 1.

ZEITSCHRIFT FÜR SOZIALFORSCHUNG. Jahrgang VIII, Doppelhelt 1/2. Fragmente über Wagner: *T. W. Adorno.* Neue sowjetrussische Literatur zur Sozialforschung III: Moderne Physik und Philosophie: *Rudolf Schlesinger.* Review of John Dewey's Logic, The Theory of Inquiry.

THE MODERN SCHOOLMAN. Vol. XVII, No. 2. The Idealism of Léon Brunschvicg: *Auguste Grégoire.* (No. 3.) Philosophy of Beauty in St. Augustine: *J. W. Naughton.*

RIVISTA DI FILOSOFIA NEO-SCOLASTICA. Anno XXXI, Fasc. IV–V. Il problema esegetico fondamentale del pensiero campanelliano (Nel III Centenario del filosofo): *Romano Amerio.*

Metafisica dell' Università: *Edgar Schorer.* (Fasc. VI) Il significato del principio di contraddizione nella logica hegeliana: *Aldo Devizzi.* Psicologia, logica e ontologia nel primo Heidegger: *Mariano Campo.* Intuizione del reale e metafisica tomista: *Michele Fatta.* Della liceità giuridica come immunità da coazione: *Basilio Sposato.*

GREGORIANUM. Anno XX, Volumen XX. Gratia supponit naturam. Zur Geschichte eines theologischen Prinzips: *J. B. Beumer.*

NOTES AND NEWS

The Thirty-Fifth Annual Meeting of the Southern Society for Philosophy and Psychology will meet March 21–23, 1940, at Tulane University, New Orleans. Marjorie S. Harris will deliver the presidential address on the subject "Mathematical Logic and Aesthetics." The two philosophy sessions will contain the following papers: "Hegel's Logic of Process" by Palmer Weber; "Dr. Broad's Refutation of McTaggart's Theory of Time" by R. L. Patterson; "Metaphysics as Structural Integrity" by F. W. Meier; "Unity of Genus, Species, and Individual in the *De Ente* of Thomas Aquinas" by K. K. Berry; "Philosophy Proper and the Philosophy of Science" by G. T. Kalif; "Definition and Defining in Plato" by W. S. Weedon; "Leibniz's Search for Adequate Psychological Categories" by L. E. Loemker; "Is a Science of Value qua Value Possible?" by L. J. Eslick; "Selfishness and Unselfishness" by George Morgan, Jr.; "The Unique Aesthetic Fact" by P. A. Carmichael; "Imitation and Expression in Art" by Iredell Jenkins; "The Consequences of Pragmatism" by W. P. Warren.

There will be a Symposium on the Philosophy of Science at which the following papers will be read: "The Postulate of Common Content" by Knight Dunlap; "Concerning the Subject-Matter of Psychology" by A. G. Balz; "Some Studies of Experimentally Induced Impairment, Showing How the Results of Any Experiment Depend on the Investigator's Pre-experimental Assumptions and His Use of the Deductive Method" by H. M. Johnson.

Information may be obtained from the Secretary-Treasurer, Norman L. Munn, Vanderbilt University, Nashville, Tennessee.